DRAFT

NOνA Configuration

Management Program

Version 1.2

October 21, 2005

NOνA Configuration Management Program

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1. PURPOSE

This Configuration Management Program (CMP) describes the configuration management (CM) responsibilities and processes that support the design and implementation of the NOνA Detector. The purpose of this CMP is to identify the organization providing the configuration control, define what a configuration-controlled item is, describe the change control process, and identify the plan for configuration status accounting and verification. This CMP is designed to ensure that:

a) Baselines are defined and documented,
b) Documentation is identified, released and controlled,
c) A Configuration Control Board (CCB) is established and functions according to CMP guidelines,
d) Changes to the baseline are evaluated and controlled,
e) Approved configuration changes are implemented and tracked, and
f) Configuration status accounting is accomplished.

Systems and components specific to the NOνA Project have been reviewed in accordance with the principles provided in ANSI/EIA-649-1998, *National Consensus Standard for Configuration Management*. "Configuration management practices should be applied selectively, and to a degree commensurate with the application environment." We have tailored the degree of rigor employed based on the functions and importance of each system or component. Table 1 provides a summary of the principles and a brief description of how each principle was addressed by the Project.

2. PROGRAM OVERVIEW

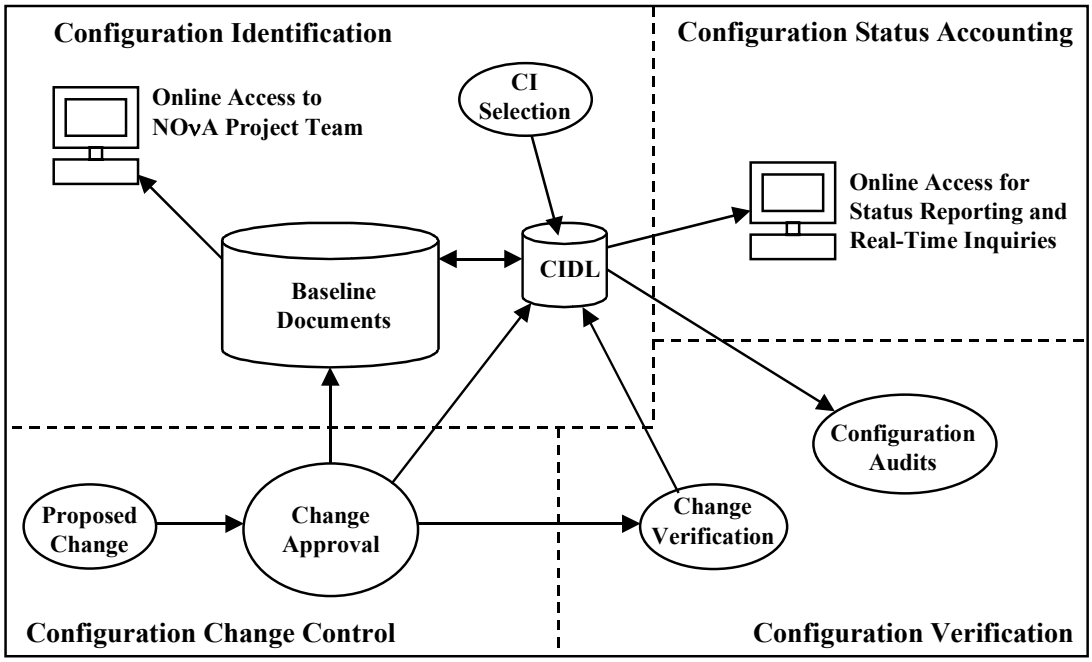
A CMP is employed by the NOνA Project to identify and control relationships with respect to design and construction of the NOνA Detector and detector hall. The Project recognizes the importance of maintaining clear, concise, and accurate records in order to stay on schedule, remain within cost constraints, and provide complete information for future operation, maintenance, and decommissioning activities. This Program has been established to ensure that key functional organizations, both internal and external to Fermilab, are aware of their roles and responsibilities during the design, construction, and testing phases of the Project. Detector design requirements and documents have been fully established and will be maintained in a way that they will be complete and accurate throughout the lifetime of the detector.

The main goal of the NOνA CM Program is to prevent unauthorized or uncontrolled physical hardware changes to equipment, changes to controlled documents, and changes to controlled software. The program integrates the various CM control systems already in place and augments where needed. It is also meant to focus on the control of active documents and not on longer-term records management, retention, or archiving. Records management issues will be addressed according to the requirements listed in DOE Order 200.1, Information Management Program.

The key elements of CM, shown in Figure 1, are Configuration Identification, Configuration Change Control, Configuration Status Accounting, and Configuration Verification. Configuration Identification defines the system through drawings and documents that specify the system components in terms of functional and physical characteristics, as well as how they will be manufactured and tested.

For convenience, the system is broken down into Configuration Items (CIs). The CIs are listed in a Configuration Items Data List (CIDL), which is a database that lists each CI and its defining documentation. The CIDL is also used to track proposed changes to CIs. The Change Control process is the vehicle by which proposed changes are reviewed and approved. It ensures that the technical, cost and schedule impacts of each major change are considered before approval is granted. Configuration Status Accounting is a means to track configuration information and relay it to key personnel in order to support management decisions and ensure that all work is performed according to the current design. The Configuration Verification process ensures that the current hardware and software configurations match the intended design by verifying the implementation of each approved change and through periodic configuration audits.

Figure 1
Key elements of NOνA Configuration management.



3. SCOPE AND APPLICABILITY

3.1 Scope

This CMP is applicable to all work performed as part of the NOνA Project, which includes the design, testing, integration, and assembly of components. It provides guidance for all personnel on CM activities in support of the Project, including all subsystem teams, collaborations, and subcontractors. CM is applied to items selected by the Project Manager and includes hardware and software components along with the related design documents, specifications, drawings, procedures and other support documents. The scope of this CMP encompasses the lifecycle of the Project.

3.2 Applicability

In general, the following classes of documents are included in the Configuration Management Program:

- Mechanical and electrical design drawings showing the specifications for the equipment and subcomponents
- Technical Design Reports
- Management documents such as the Baseline Schedule, PMP, MoU's, and SOW's.

4. ACRONYMS AND DEFINITIONS

4.1 Acronyms

CCB – Configuration Control Board
CI – Configuration Item
CIDL – Configuration Items Data List
CM – Configuration Management
CMP – Configuration Management Program
CR – Change Request
DCN – Document Change Notice
ICD – Interface Control Document
L2 Manager – Person responsible for activities at Level 2 of the Work Breakdown Structure
L3 Manager - Person responsible for activities at Level 3 of the Work Breakdown Structure
MoU- Memorandum of Understanding
PAC – Physics Advisory Committee
PEP – Project Execution Plan
PM – Project Manager
PMG – Project Management Group
PMP – Project Management Plan
SOW- Statement of Work
TDR – Technical Design Report

4.2 Definitions

Baseline – The point at which a project design or requirements are "frozen" and after which all changes must be tracked and approved.

Change Classification - All proposed changes to Project documentation submitted to the CCB for consideration are designated as Class I, II, or III changes. Configuration changes may affect hardware, software, verification requirements and the documents, drawings and procedures, which define them.

Class I Change – A proposed change that impacts the form, fit, or function of the Detector. Class I changes are Out-of-Scope changes that would alter the physics capabilities of the detector in a major way or introduce a new detector system. This is described further in the NOνA PMP.

Class II Change – A change that does not alter the Scope of the Project as defined in the NOνA PMP. These are In-Scope.

Class III Change – A proposed change that is not classified as Class I or II. This includes changes that affect the design of a subsystem but do not change the ability of that subsystem to meet its functional and design requirements. Changes to correct clerical errors or to add clarification to documents are also classified as Class III. Class III changes are authorized by the manager of the originating organization.

Configuration Control Board (CCB) – A board composed of technical and administrative representatives who recommend approval or disapproval of proposed changes to a CI's current approved configuration documentation. This is currently considered to be the NOνA PMG.

Configuration Item (CI) – An aggregation of hardware or software that satisfies an end use function.

Configuration Items Data List (CIDL) – A NOνA Project-controlled database that identifies all CIs and contains tracking and status information for changes to the CIs.

Configuration Management (CM) – The systematic control and evaluation of all changes to documentation that has reached a baseline point.

Pending Changes - Pending changes are those for which conceptual design has been approved, changes that have been approved for implementation, or approved unincorporated changes that have been implemented in the field but for which the document revision has not been completed.

Technical Design Report – Defines the technical specifications, physical characteristics, and functional operating parameters of the NOνA Detector.

5. RESPONSIBILITIES

5.1 Project Manager

The Project Manager is responsible to:

• Oversee and coordinate project configuration control activities;
• Approve all changes to the project cost and schedule baselines;
• Notify the Project Management Group of any need to change a document or system as soon as that need is identified and determined to be valid;
• Ensure that all project CIs are identified and controlled;
• Ensure any changes to controlled documents are appropriately recorded, tracked, and incorporated into existing drawings or documents in a timely manner;
• Ensure any additional testing or certification required as a result of changes are explicitly called out and included in the appropriate places;
• Maintain a database that identifies controlled documents and owners of those documents for the Project;
• Periodically audit the CM Program to determine the effectiveness of the Program. This may include reviewing controlled copies of documents to ensure their accuracy and their consistency with the master copies.

5.2 Level 2 Managers

Level 2 Managers are responsible to:

• Maintain CM control over their areas of responsibility and subcontractors;
• Notify the PM of any need to change a document or system as soon as that need is identified and determined to be valid;
• Ensure the PM is informed of as-built changes and revisions to controlled documents,
• Assess impacts of proposed changes on cost, schedule, resources, risk, technical performance, and scientific objectives;
• Implement approved changes to the project cost and schedule baselines.

5.3 Level 3 Managers

Level 3 Managers are responsible to:

• Keep track of progress on work activities under their control, including work by subcontractors and collaborations;
• Notify the Level 2 Manager of any need to change a document or system as soon as that need is identified and determined to be valid;
• Ensure that people under their authority use the latest versions of documents available,
• Transmit changes made as a result of fieldwork up the chain of command in an orderly and timely manner.

5.4 Document Control Managers

Document Control Managers are responsible to:

• Ensure that only the latest versions of documents are disseminated and available for use and outdated documents are replaced throughout the system. If outdated documents are requested for any reason, they shall be labeled as outdated or obsolete in a clear and distinctive manner.

6. CONFIGURATION MANAGEMENT PROCESS

The CM process consists of four ongoing stages: (1) configuration identification, (2) change control, (3) configuration status accounting, and (4) configuration verification.

6.1 Configuration Identification

Configuration identification is the ongoing process of identifying and documenting the detector's functional and physical characteristics, from initial requirements selection through design, development, fabrication, test, and delivery. Configuration identification provides unique identity to detector components as well as the configuration documentation.

6.1.1 Baseline Definition

The configuration identification is developed and maintained via the peer review process and a series of formal technical and management reviews. The peer review process includes the Physics Advisory Committee, the NOνA Collaboration, and the Project Management Group. Formal reviews are conducted by the Fermilab Directorate, the Department of Energy, and outside consulting groups in the employ of the DOE.

6.1.2 Configuration Items

In order to facilitate CM, the detector systems and components will be broken down into manageable units, called Configuration Items (CIs). CIs are identified through a top-down analysis that divides the total system into logically related and subordinate aggregates of hardware and/or software. The main criteria is to select those items whose performance parameters and physical characteristics can be separately defined, tested, and managed.

6.1.3 Configuration Items Data List

All CIs will be listed in a Configuration Items Data List (CIDL). The CIDL is a database containing relevant information about each CI, such as item number, title, revision history, responsible organization and manager, release date, etc. The CIDL will also identify the documents that define the CI. These documents are controlled through CM and may include, but are not limited to, specifications, drawings, interface control documents (ICDs), software description documents, databases, and procedures. Where the design incorporates commercial off-the-shelf (COTS) hardware or software, the vendor part number will be used in drawings and specifications. The design data and documentation owned by the vendor is not subject to, and therefore not included in, the NOνA Project CMP.

6.2 Change Control

Change control is the process by which the NOνA Project Office manages and approves the release and update of configuration-controlled items. This process aims primarily at ensuring that only currently approved revisions of documents are in use. Tracking features support this aim through the maintenance of information on the current status of documents and the provision of information on pending changes. The major features for effective control are discussed below.

6.2.1 Initial Release

Drawings and documents are placed under configuration control upon their initial release. Prior to initial release, the originator should submit the item to peer or expert review, as applicable. Initial release is accomplished by submitting a completed and approved Document Change Notice (DCN) to the Project Manager via the appropriate L2 or L3 Manager. The item is then entered into the CIDL. Secure master files of the original documents are maintained in the appropriate place. If the document is created by an off-site facility, the off-site entity may retain control of the master file with the express authorization of the NOνA Project Manager.

6.2.2 Change Control Process

Updates to released documents are accomplished through the change control process. This process is used to classify proposed changes and manage the approval process accordingly. All proposed changes are assigned a classification of Class I, Class II or Class III based on the level of impact to the overall system. Refer to the NOνA PMP for more detailed information about the specifics of the change control process. The change control process is started when a need for change is identified and the responsible person submits a Document Change Notice (DCN) to the appropriate manager for approval. Class III changes are managed and controlled at the subsystem level. The DCN is used to inform the rest of the team of approved changes and to cause the CIDL to be updated. If

the proposed change requires PMG approval, then the DCN and an accompanying Change Request (CR) are forwarded. Prior to the PMG meeting, the PM conducts an informal screening to make sure the CR is complete and accurate. The PM may request additional support documentation, reports and/or analyses for the PMG presentation. The PMG then evaluates the CR and recommends that it be approved or rejected. Class I changes are then sent to DOE for approval as per Section 8 of the NOνA PMP. When the appropriate level of approval has been granted, the DCN and CR forms are routed and distributed to the Project team. The approved CR directs the Project team to implement the change. The Project Manager will convene a formal, internal technical review panel if dramatic technical changes become necessary during the course of the Project. This review will address questions relating to the need for the proposed change, the benefits versus the cost and schedule impacts, and the availability of adequate resources to successfully complete the change. The change control thresholds and responsibilities are summarized in Table 1.

Table 1. Change control thresholds and responsibilities.

	Fermilab Associate Director (Level 3)	**NOνA Project Manager (Level 4)**	**Subproject Manager (Level 5)**
Technical	Major technical changes that are significant departures from the technical baseline. Changes that affect ES&H requirements or impact accelerator systems. Out-of-scope changes to upgrade physics capabilities.	Related technical changes to multiple subprojects that do not diminish performance.	Minor technical changes to a single subproject that does not diminish performance.
Schedule	Any change that results in the delay of a Level 3 Director's milestone.	Any change that results in the delay of a Level 4 milestone by more than one month.	Any change that results in the delay of a Level 5 milestone by more than one month
Cost	Increase in the cost of a single item by more than $200K. Increase in the Project base cost exceeding $500K during the previous 12 months.	Increase in the cost of a single item by more than $50K.	Increase in the cost of a single item by less than $10K.

6.2.3 Document Change Notice

A Document Change Notice form is used to notify the Project team that an approved change has been implemented. The DCN may announce the release of a new revision or may be attached as an amendment to the current revision.

6.2.4 Change Request Form

The Change Request form accompanies the DCN when submitting a proposed change. The CR provides the information about the technical performance, cost and schedule impacts of the proposed change.

6.2.5 PMG Operations

The PMG is primarily responsible for reviewing all Class I and Class II CRs for merit based on the impact to cost, schedule and technical performance. The PMG may also be called on to evaluate and approve or reject Collaboration change requests and subcontractor requests for deviation or waiver.

6.3 Configuration Status Accounting

The CIDL provides the ability to track all changes to CIs. The database will contain information providing traceability and status of all change requests. The CIDL will maintain the change history of all CIs so that the evolution of the system will be documented. The CIDL serves as the vehicle for communicating the status of configuration through periodic reports and direct real-time inquiries.

6.4 Configuration Verification

The Subsystem Managers are responsible for implementing and closing the PMG-approved changes to CIs that are under their control. The DCN serves as notice that a document change has been implemented and verified. The verification of hardware changes is reported by signing the bottom of the CR form and returning it to the PM. In this manner, all changes can be tracked to completion and easily audited. All CIs will be audited prior to delivery for integration into the higher-level system to ensure that the as-built configuration conforms to the configuration documentation.

Figure 2
NOνA Document Identification and Control

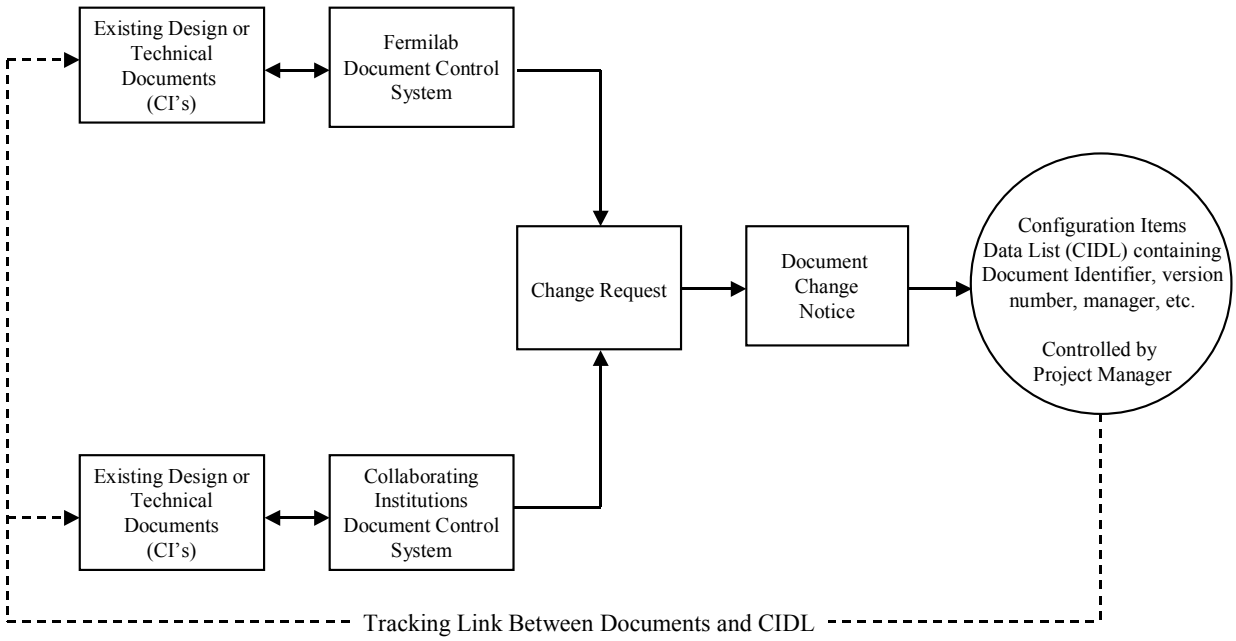


Figure 3
NOνA Configuration Management Flowchart

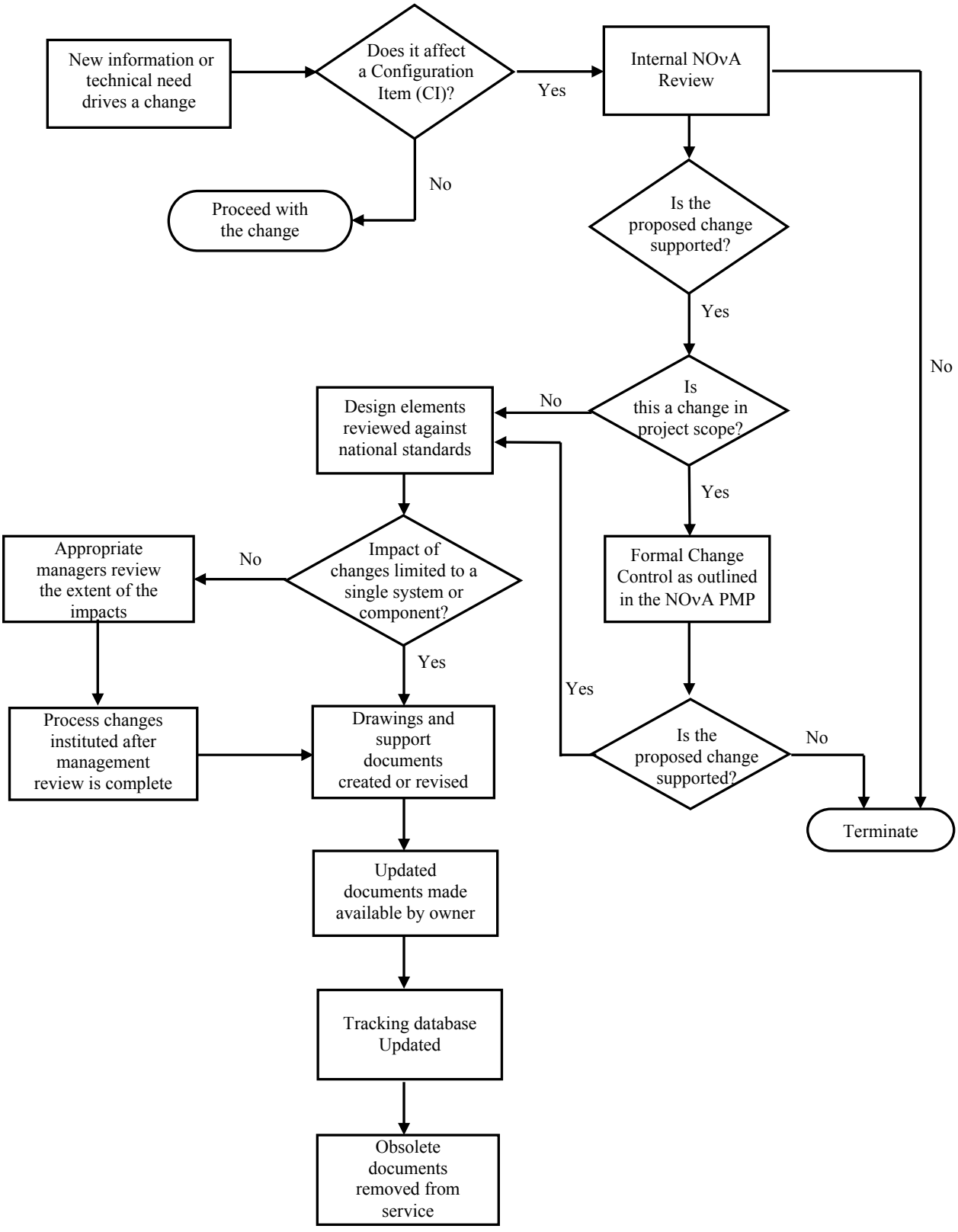


Table 2. ANSI/EIA-649-1998 Summary of Configuration Management Principles

No.	Principle	How it is Addressed
1.	Plan CM processes for the context and environment in which they are to be performed and manage in accordance with the planning: assign responsibilities; train personnel; measure performance; and assess measurements/trends to effect process improvements.	In the CMP
2.	To determine the specific CM value adding functions and levels of emphasis for a particular product, identify the context and environment in which CM is to be implemented	In the CMP
3.	A configuration management plan describes how configuration management is accomplished and how consistency between the product definition, the product's configuration, and the configuration management records is achieved and maintained throughout the applicable phases of the product's life cycle.	In the CMP
4.	Prepare procedures to define how each configuration management process will be accomplished.	Figure 3 (Flowchart)
5.	Conduct training so that all responsible individuals understand their roles and responsibilities and the procedures for implementing configuration management processes.	Regular meetings with L2 Managers
6.	Assess the effectiveness of CM plan implementation and performance of the configuration management discipline with defined metrics (performance indicators).	PM Responsibilities
7.	Performing configuration management includes responsibility for the configuration management performance of subordinate activities (e.g., subcontractors, suppliers).	L2 and L3 Manager responsibilities
8.	Configuration identification is the basis from which the configuration of products are defined and verified; products and documents are labeled; changes are managed; and accountability is maintained.	PMP Change Control
9.	Configuration documentation defines the functional, performance, and physical attributes of a product. Other product information is derived from configuration documentation.	Described in *The* NOνA *Technical Design Report* (TDR)
10.	The product composition (i.e. relationship and quantity of parts that comprise the product) is determinable from its configuration documentation.	Described in the TDR
11.	All products are assigned unique identifiers so that one product can be distinguished from other products; one configuration of a product can be distinguished from another; the source of a product can be determined; and the correct product information can be retrieved.	Serial #'s and test data
12	Individual units of a product are assigned a unique product unit identifier when there is a need to distinguish one unit of the product from another unit of the product.	Serial #'s
13	When a product is modified, it retains its original product unit identifier even though its part identifying number is altered to reflect a new configuration.	Not Applicable
14.	A series of like units of a product is assigned a unique product group identifier when it is unnecessary or impracticable to identify individual units but nonetheless necessary to correlate units to a process, date, event, or test.	Not Applicable

No.	Principle	How it is Addressed
15.	All documents reflecting product performance, functional, or physical requirements and other product information are uniquely identified so that they can be correctly associated with the applicable configuration of the product	Described in the TDR
16.	A baseline identifies an agreed-to description of the attributes of a product at a point in time and provides a known configuration to which changes are addressed	Described in the TDR
17.	Baselines are established by agreeing to the stated definition of a product's attributes	Described in the TDR
18.	The configuration of any product or any document, plus the approved changes to be incorporated is the current baseline.	Described in the TDR
19.	Maintaining product information is important because time consuming and expensive recovery may be necessary if records of operational units of a product do not match the actual units (as reported by maintenance activities) or such records do not exist.	Serial #'s
20.	For product interfaces external to the enterprise, establish an interface agreement and a mutually agreed to documentation of common attributes	MOU's and SOW's
21.	Changes to a product are accomplished using a systematic, measurable change process.	PMP Change Control
22.	Each change is uniquely identified.	Change Request and DCN
23.	Changes represent opportunities for improvement.	Change Request and DCN
24.	Classify requested changes to aid in determining the appropriate levels of review and approval.	PMP Change Control
25.	Change requests must be clearly documented.	PMP Change Control
26.	Consider the technical, support, schedule, and cost impacts of a requested change before making a judgment as to whether the change should be approved for implementation and incorporation in the product and its documentation	PMP Change Control
27.	Determine all potential effects of a change and coordinate potential impacts with the impacted areas of responsibility	See Figure 3 (flowchart)
28.	Change documentation delineates which unit(s) of the product are to be changed. Change effectivity includes both production break-in and retrofit/recall, as applicable	Not Applicable
29.	A changed product should not be distributed until support and service areas are able to support it.	Not Applicable
30.	Decision-maker is aware of all cost factors in making the decision.	PMP Change Control
31.	Change approval decisions are made by an appropriate authority who can commit resources to implement the change	PMP Change Control
32.	Implement an approved change in accordance with documented direction approved by the appropriate level of authority	PMP Change Control
33.	Verify implementation of a change to ensure consistency between the product, its documentation and its support elements	See Figure 2 (flowchart)
34.	If it is considered necessary to temporarily depart from specified baseline requirements, a variance is documented and authorized by the appropriate level of authority	PMP Change Control

No.	Principle	How it is Addressed
35.	An accurate, timely information base concerning a product and its associated product information is important throughout the product life cycle.	Figures 2 & 3
36.	Configuration information, appropriate to the product, is systematically recorded,	Outlined in CMP
37.	Configuration information content evolves and is captured over the product life cycle as tasks occur.	Outlined in CMP
38.	Data collection and information processing system requirements are determined by the need for configuration information	Outlined in CMP
39.	Verification that a product's requirement attributes have been met and the product design meeting those attributes has been accurately documented is required to baseline the product configuration	Quality Management & Reviews
40.	Verification that a design achieves its goals is accomplished by a systematic comparison of requirements with the results of tests, analyses, or inspections	Quality Management & Reviews
41.	Documentation of a product's definition must be complete and accurate enough to permit reproduction of the product without further design effort.	Quality Management & Reviews
42.	Where necessary, verification is accomplished by configuration audit	Outlined in CMP
43.	Periodic reviews verify continued achievement of requirements, identify and document changes in performance, and ensure consistency with documentation	Quality Management
44.	Apply configuration management principles to ensure the integrity of digital representations of product information and other data	Document Version Control
45.	Apply digital data identification rules to maintain document, document representation, and file version relationships	Document Version Control
46.	Apply business rules using data status levels for access, change management, and archiving of digital data documents	Not Applicable
47.	Maintain relationships between digital data, data requirements, and the related product configuration to ensure accurate data access.	Document Version Control
48.	Apply disciplined version control to manage document review electronically.	Document Version Control
49.	Ensure that a transmitted digital data product is usable.	Quality Management
50.	Effective digital data access fulfills requirements, preserves rights, and provides users with data they are entitled to in the correct version.	Not Applicable

Approvals: **DISTRIBUTION**

	NOνA Project Office **CHANGE REQUEST (CR)**	CR No. (Assigned by PM) NOνA-CR- Date: Rev. Date Page 1 of ___

Title					
Originator:		Email:			
WBS:		Change Type: ___Technical	___Schedule	___Cost	
Affected Items:					
CCB ACTION ___Accepted	___Rejected	___Other	**DATE:**		
Explanation:					
Level of Change	___1 (DOE)	___2 (DOE)	___3 (Directorate)	___4 (NOνA PM)	___5 (Level 2 Manager)

Short Description:

Very briefly, describe:

- What is being requested
- Why it's necessary
- What it costs, current budget available and cost difference
- Impact on other costs (if none, so state)
- Impact on schedule and milestones (if none, so state)
- Impact to interfaces and other activities (if none, so state)
- Indicate any ES&H impact
- Other pertinent information, if necessary

FUNCTION	SIGNATURE	DATE
L2 Manager		
Responsible Project Engineer		
Project Manager		
Directorate		
Other (specify)		

NOνA Project Office

CHANGE REQUEST (CR)

CR No.
NOνA-CR-

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Continuation:

	NOvA Project Office **DOCUMENT CHANGE NOTICE (DCN)**	DCN No. (Assigned by PM) NOvA-CN- Previous DCN No. (if applicable) Date: Rev. Date

Change Title	
Originator:	Email:
WBS:	Document, System or Component:
CCB ACTION **DATE:** ____ Accepted ____ Rejected ____Other	Hardware Change ____YES ____ NO Software Change ____YES ____ NO Record Change Only ____YES ____ NO
CHANGE DESCRIPTION (FROM/TO):	
Serial or ID#s of affected systems or components	
Reason for Change	
Acknowledgements/Completed Actions	
Originator	Document Manager
Level 2 Manager	CIDL Update Complete
Relevant Project Engineer	Other (specify)